

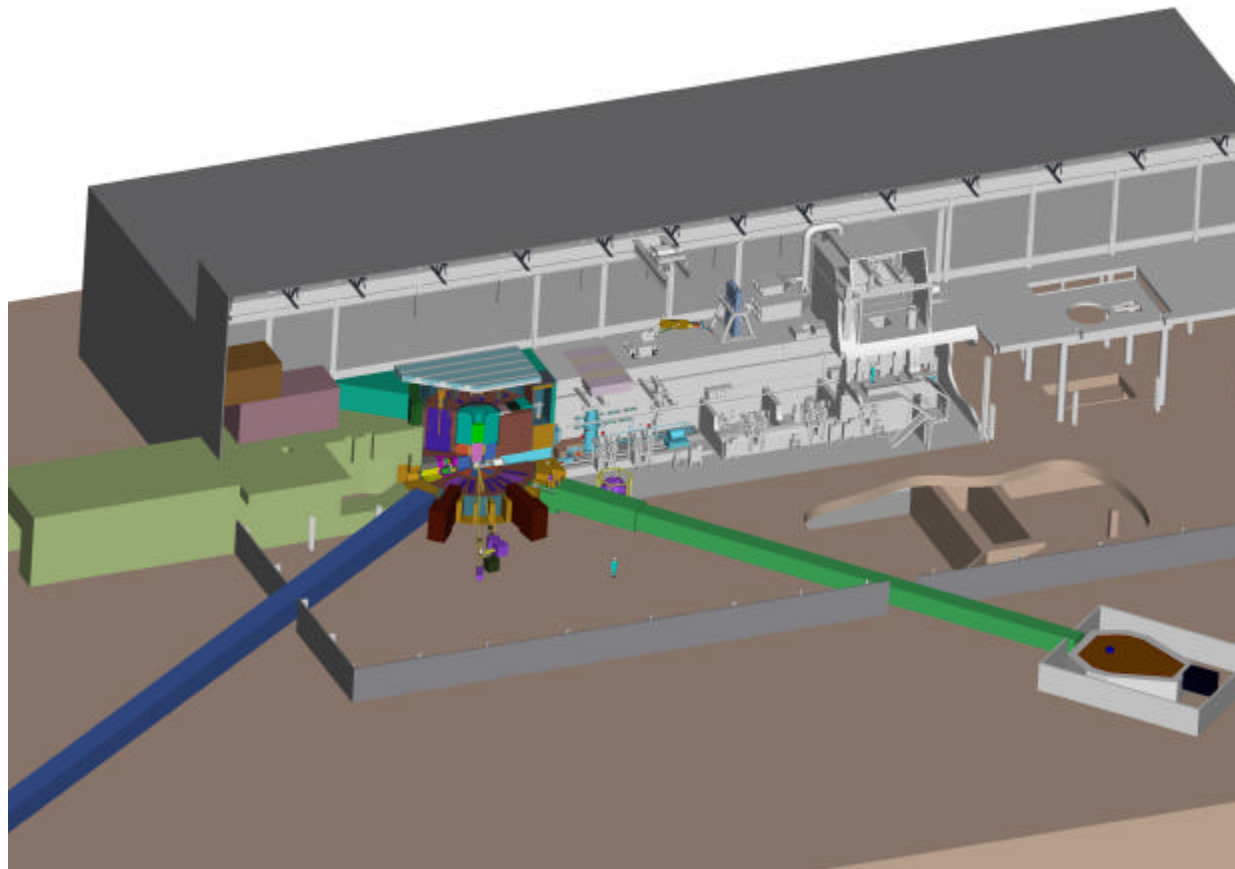
# WBS 1.6.5 Target Station Shielding Seismic Issues

**Ken Chipley**  
***Level 3 Task Leader***

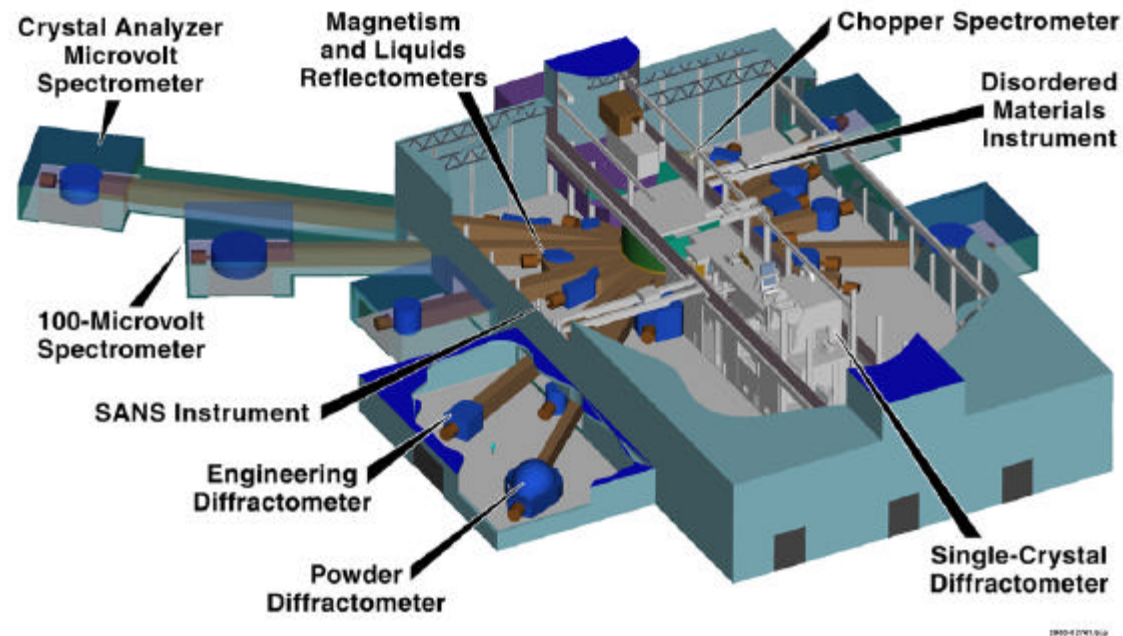
SNS Project Office  
Oak Ridge, TN  
May 9, 2000

# SNS High Power Target Station

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# Instrument Planning

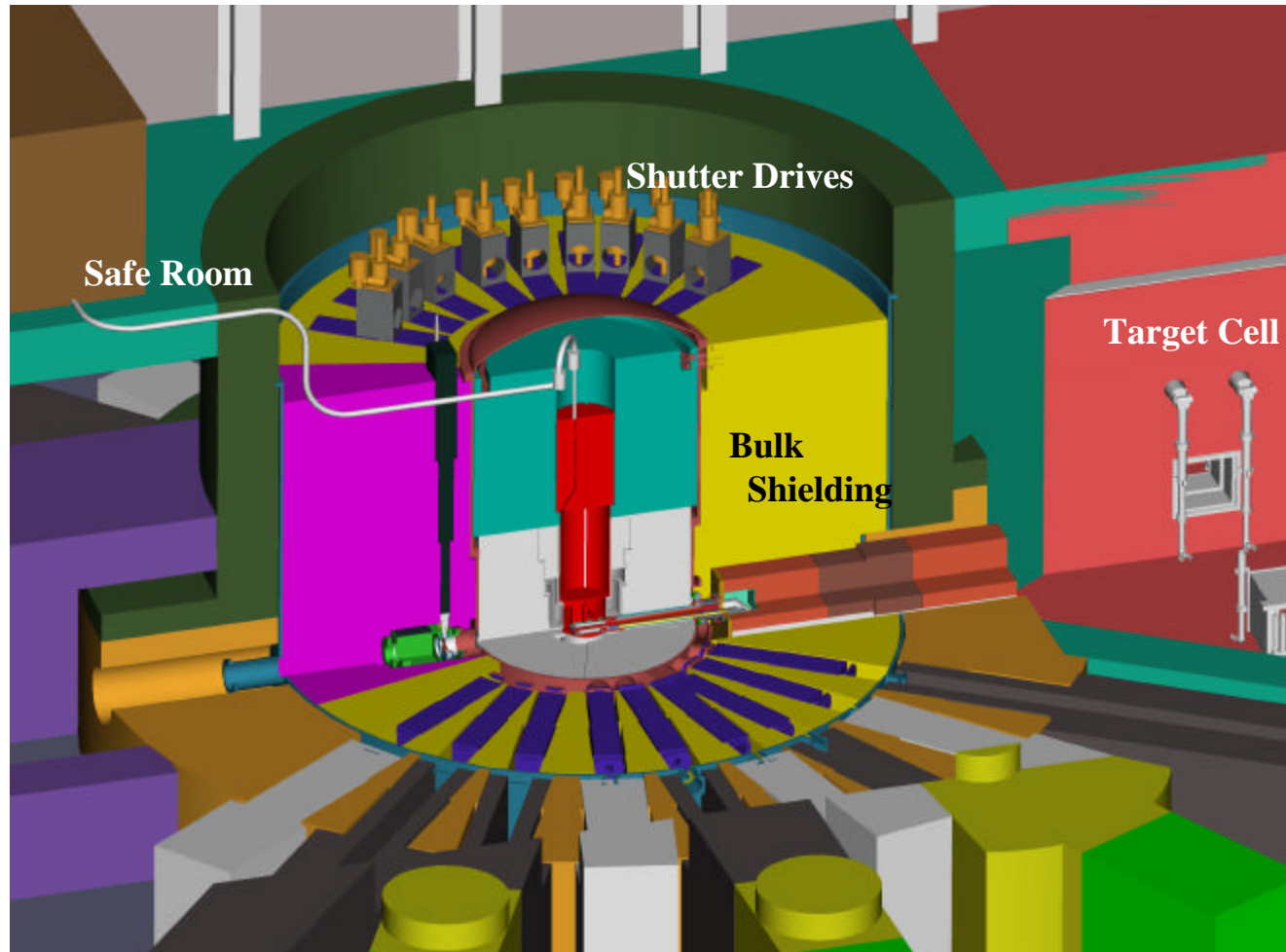


- A full, 24 instrument, experimental hall layout has been developed to provide constraints on target/conventional interfaces and facilitate instrument planning
- Includes instrument under study plus realistic “placeholders”

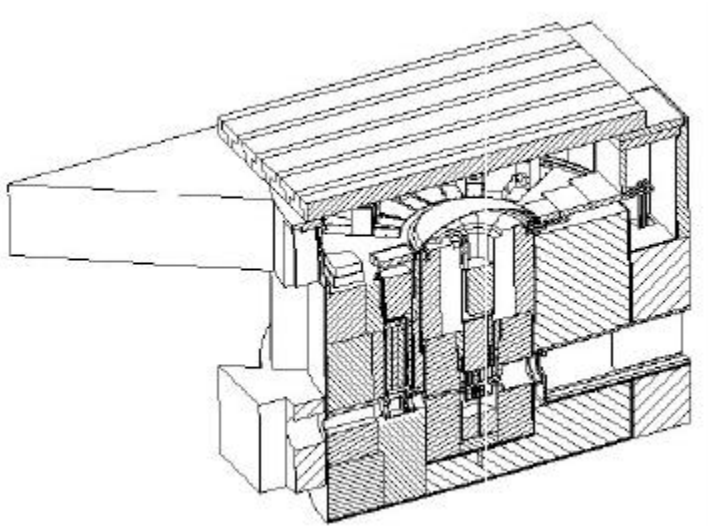
2000-03453/arb

# Target Systems: Target Station Cutaway

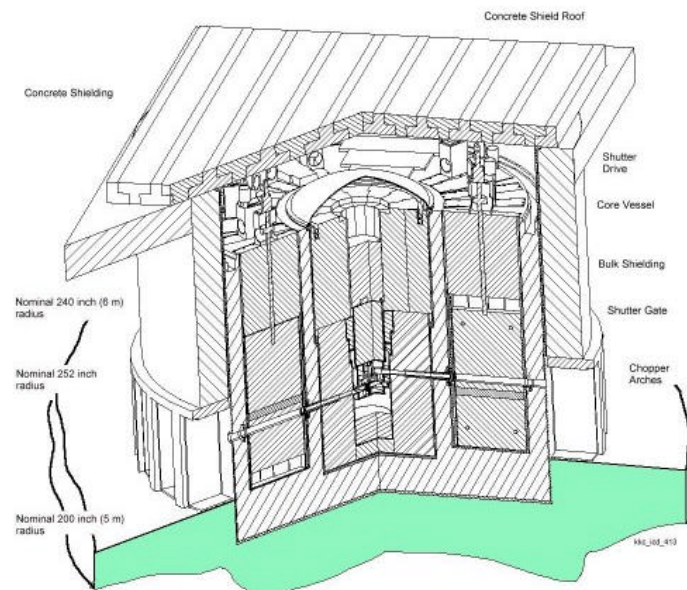
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# Target Station Section Views



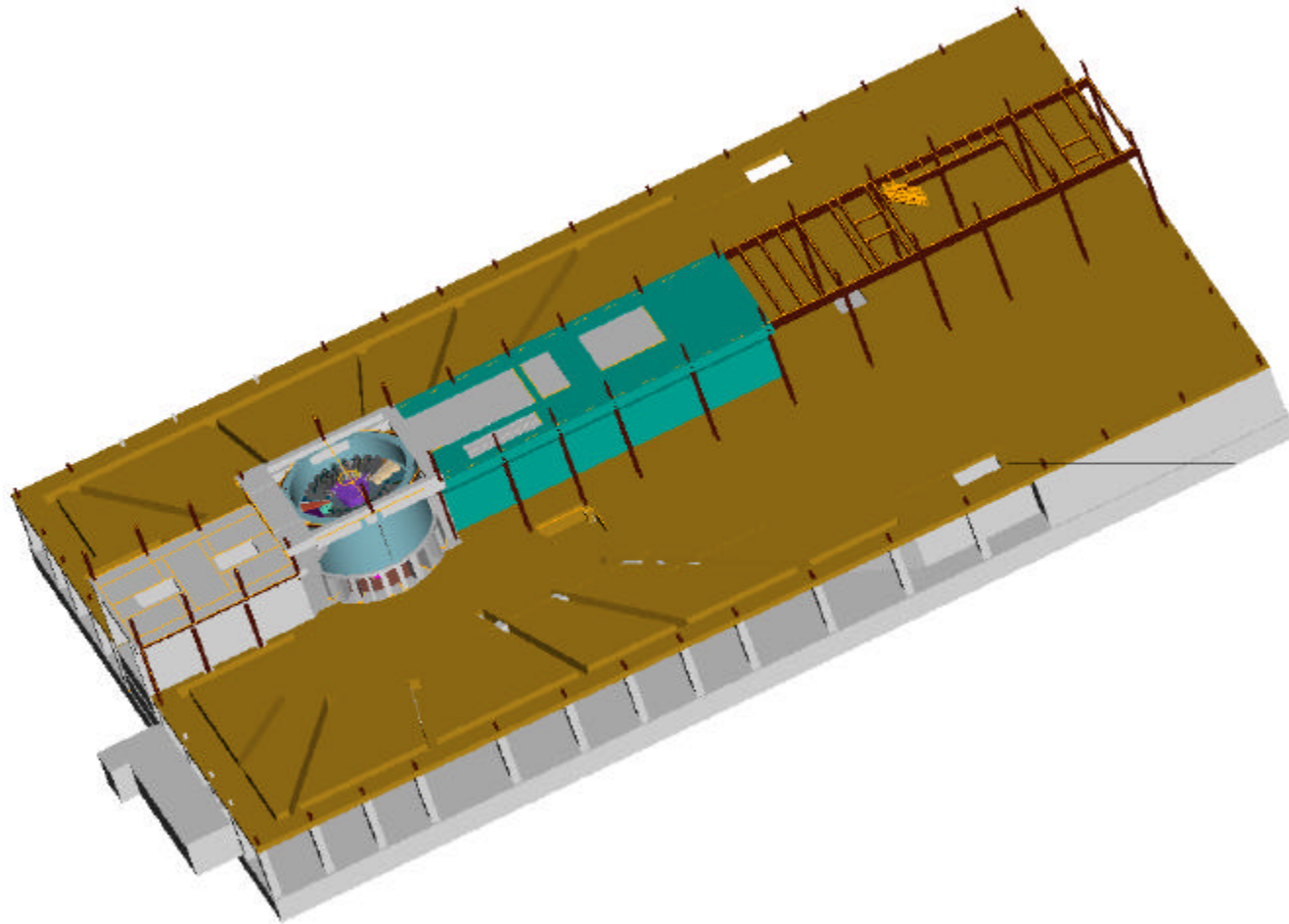
Thru Proton Beam



Thru Neutron Channels

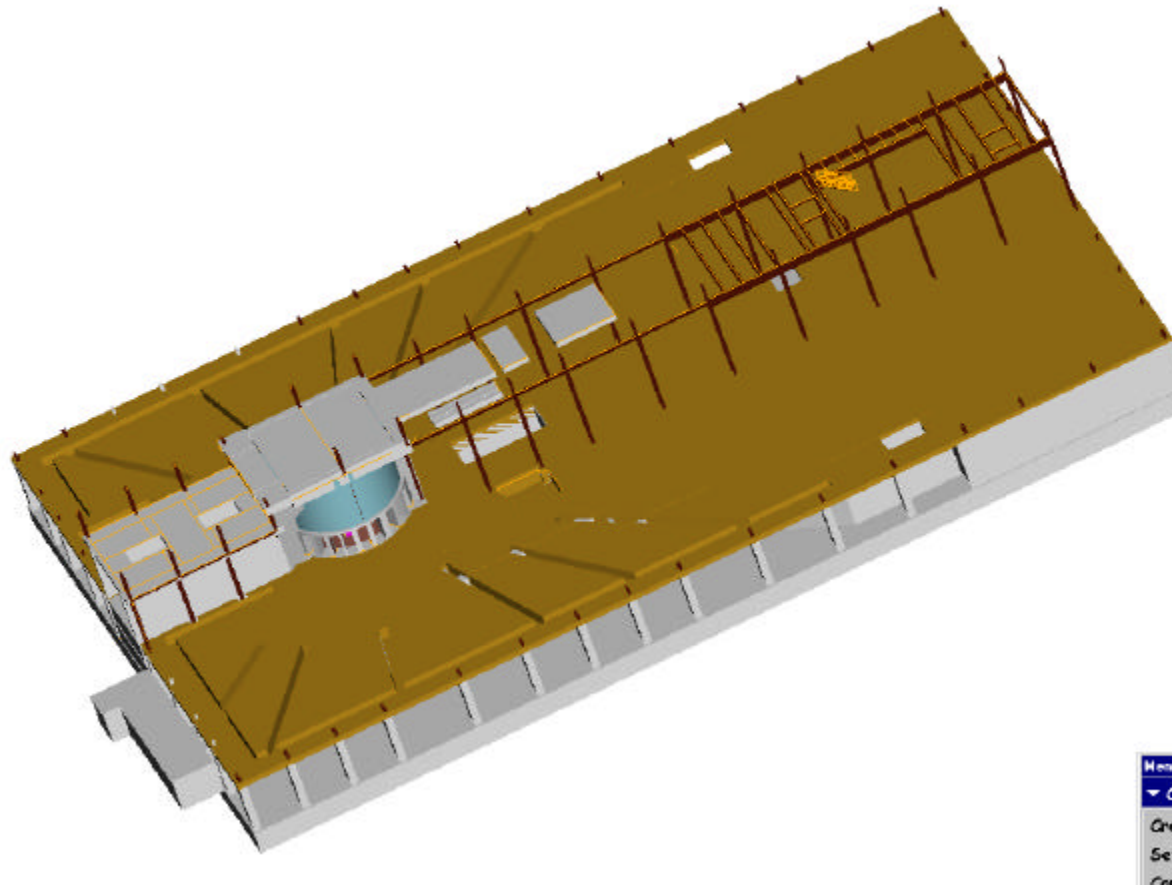
# Knight Model with TS Shielding

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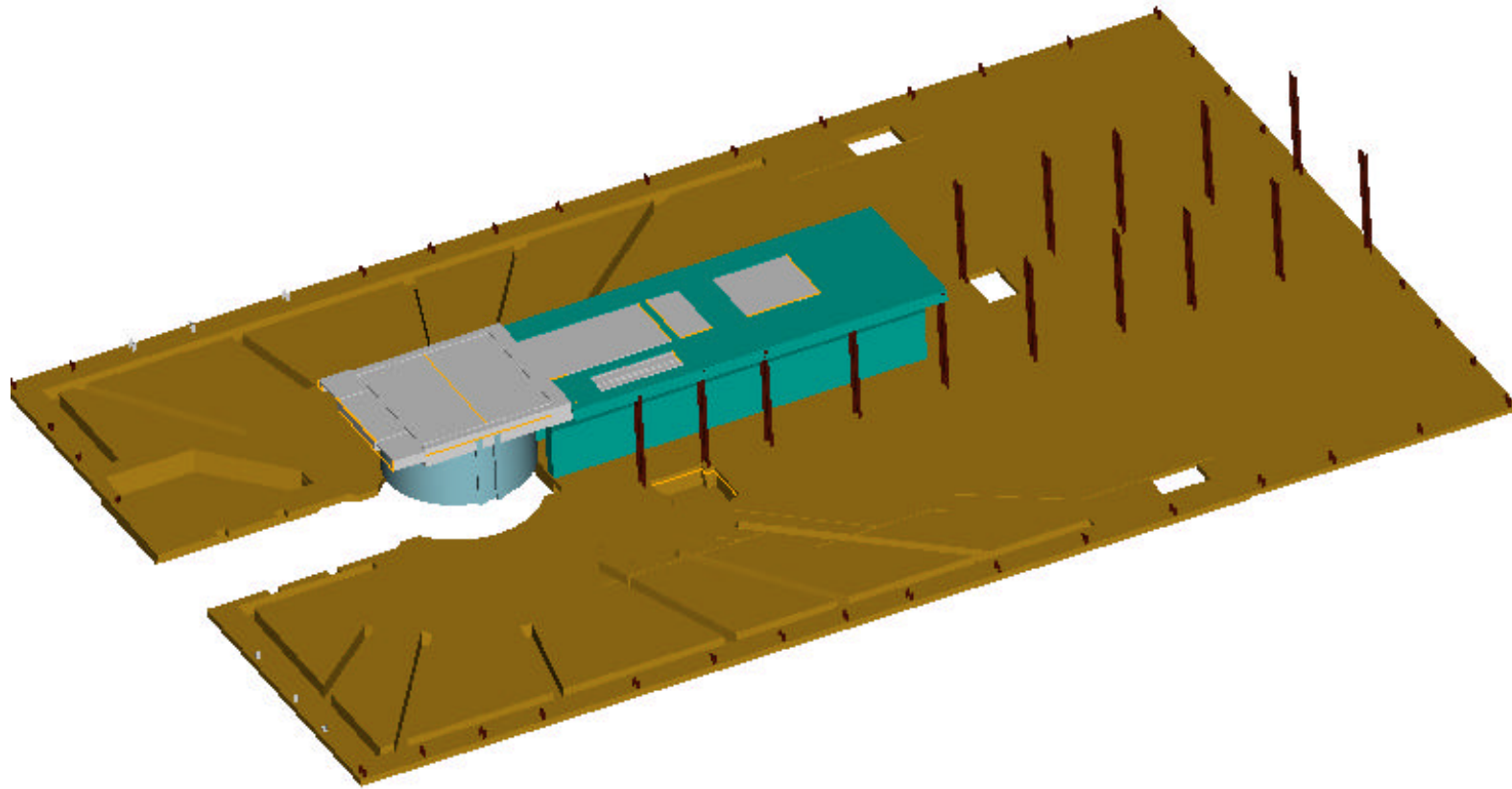


# Removed the Target Cell



# Instrument Floor

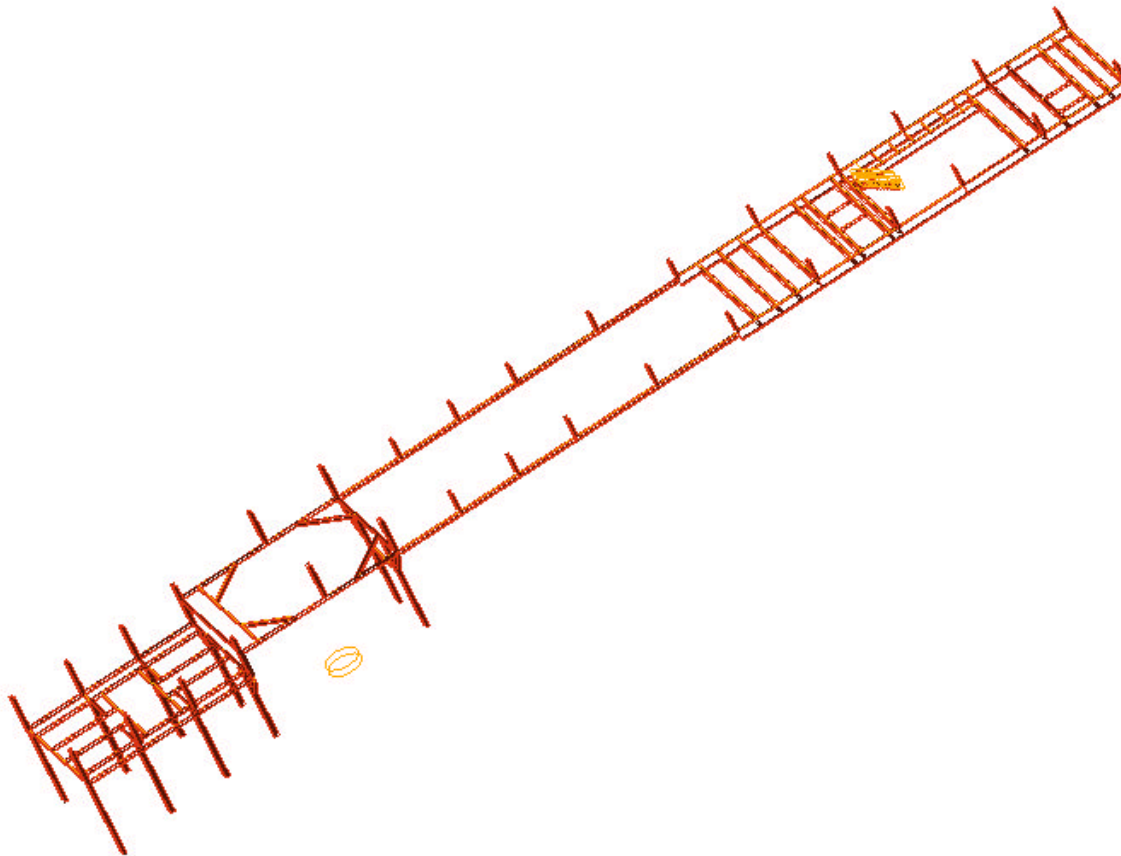
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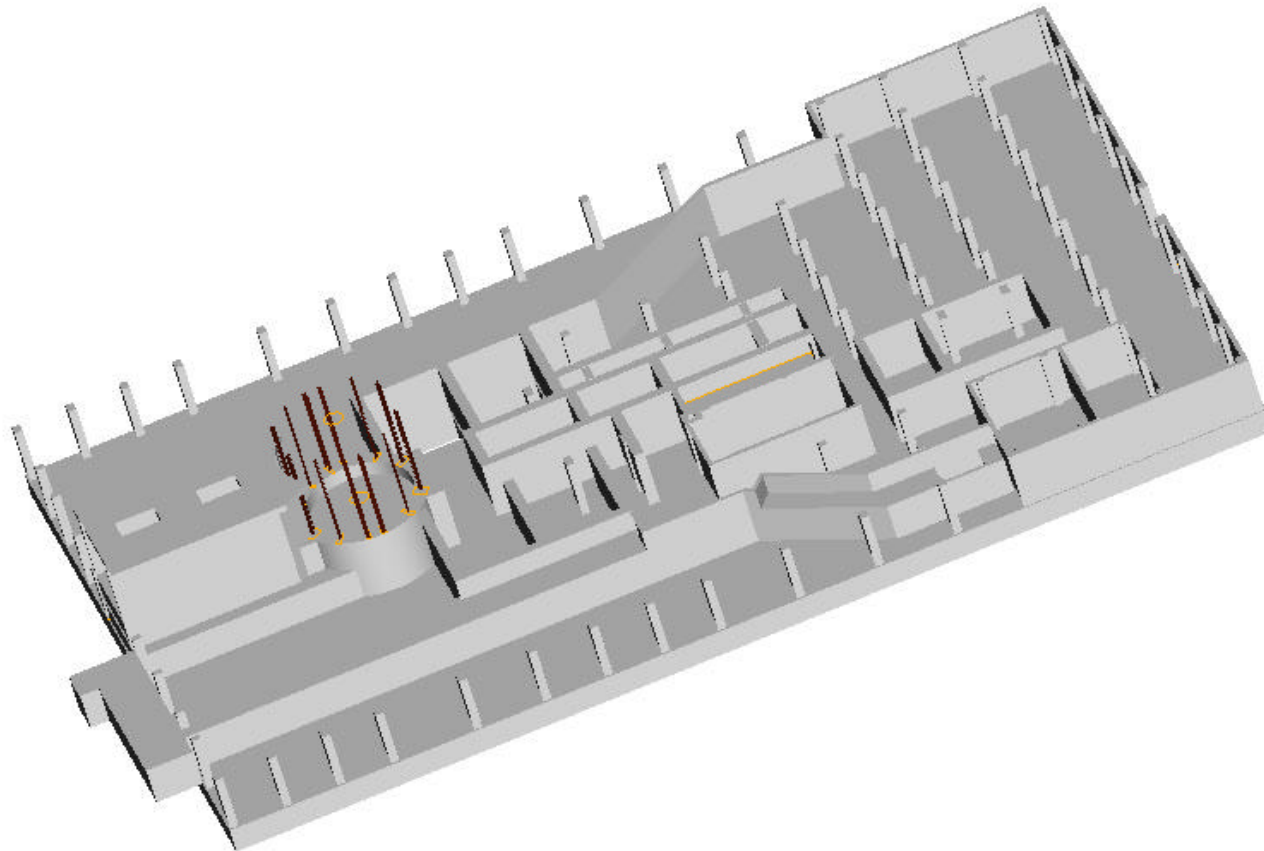
# Frame Work

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# Lower Level Concrete

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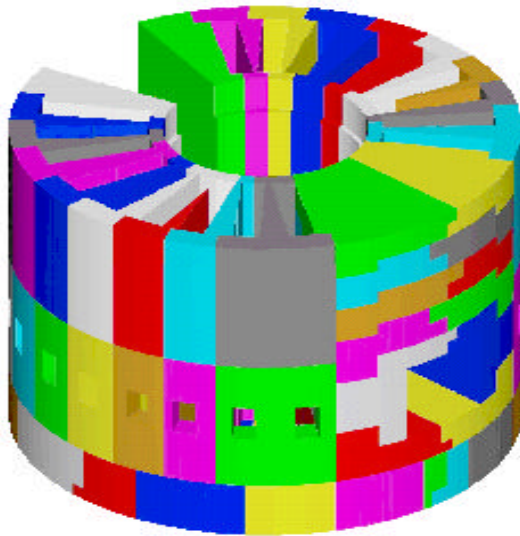


# Shielding Systems Major Subsystems



- **Bulk Shielding Components** - Shield blocks located inside the liner (400" diameter) and external to the reflector vessel (140" diameter) and the chopper archways out to 504" diameter.
- **External Shell and Liners** – Steel liner (about 400" diameter and 320" tall) that surrounds the shielding and the rectangular liner that surrounds the target cart.
- **Shutter Systems** – 18 shutters consisting of a large vertically translating shutter gates guided by channels and supported by columns.
- **Roof Structure** – Roof structure and shine shield directly above the target shielding composed of reinforced concrete beams and sealing membrane.

# Bulk Shielding Components



Bulk Shield Assembly



Interstitial Block

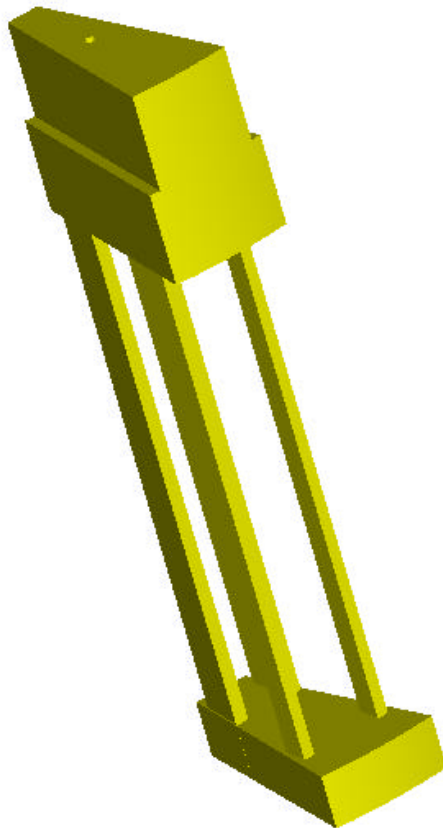
- Mostly are irregularly shaped steel blocks.
- Intent is to fill the volume with material not otherwise occupied.
- Volume is about 33 ft. diameter and about 27 ft tall.
- Almost 5000 tons of steel shielding.
- Considering using “non-prime” steel slabs as a raw material.

# Bulk Shield Components

- Primary purpose is to fill the space around the shutters with steel (or other suitable shielding materials).
- Must support the shutter gates.
- Must resist the lateral loads due to seismic conditions.
- Desirable to keep the shutters relatively independent



# Bulk Shield Shutter Support



- Each of the shutter gates would be supported inside the frame
- Major components are:
  - Bottom Block
  - Columns
  - Top Block
- Top Block is removable



# Bulk Shield Interstitial Blocks



- These blocks are laminated from plasma cut blocks of “non-prime” steel.
- Either welded or tie bolted.
- These blocks will each have a unique cross section.

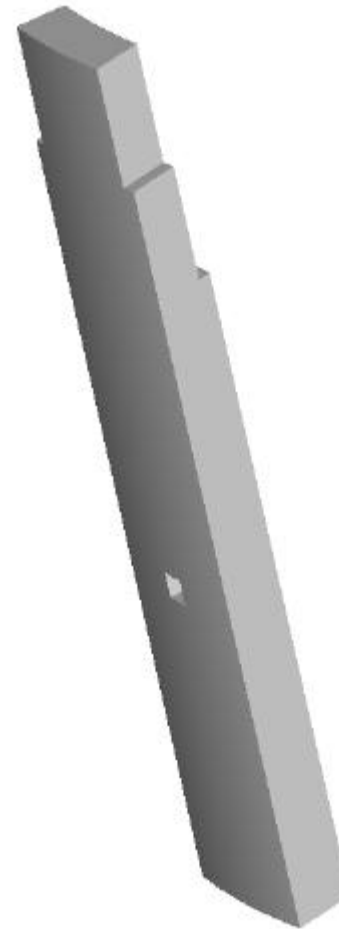
# Bulk Shield

## Outboard and Inboard Blocks

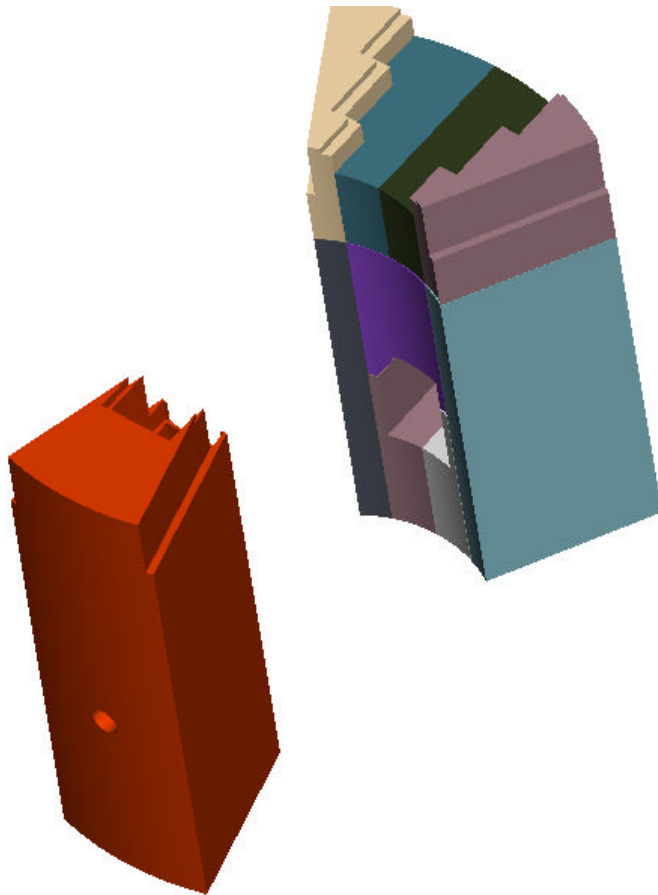
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- This image shows a volume at the outboard side of the shutter
- This volume will probably not be a single block
- Multiple small blocks around the neutron beam port will allow for this region to be reconfigured.



# Forward and Backward Regions



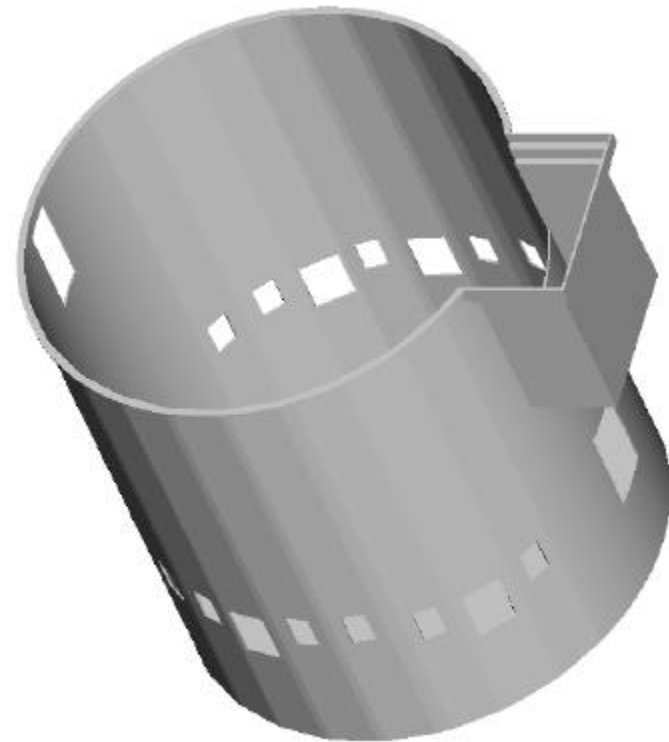
- These areas will be composed of multiple blocks
- The forward region will be designed to support the target cart.
- The backward region will provide the interface to the exterior of the proton beam tube.

# Bulk Shield Liner

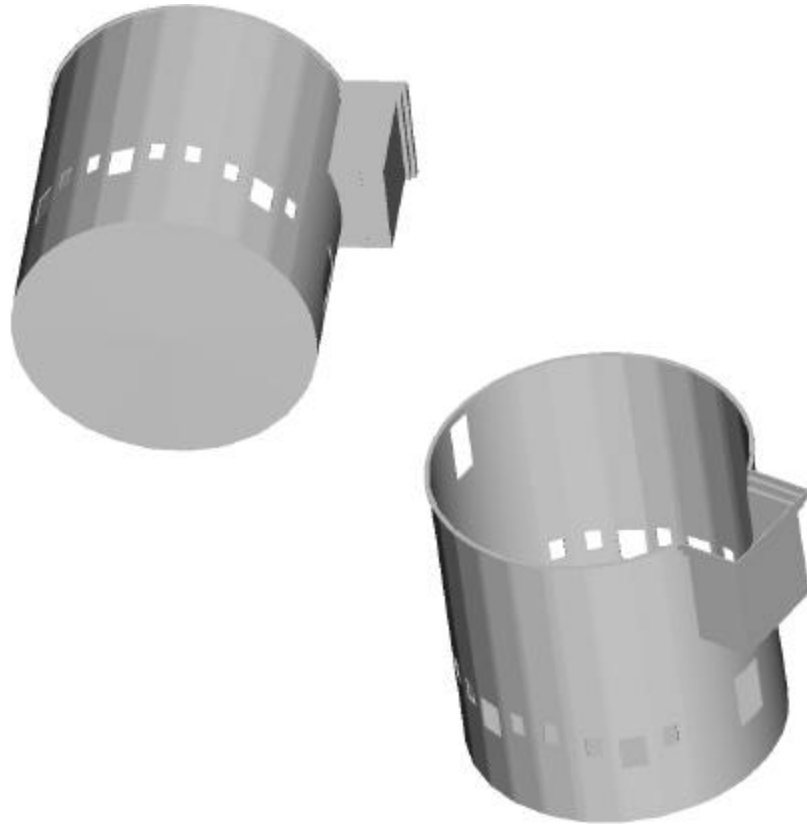
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- Liner provides barrier between slightly activated air inside to the clean air outside on the instrument floor.
- It also provides a barrier for liquids that might leak (water, oils, possibly mercury).
- Material will be carbon steel with on-site assembly of shop fabricated sections.



# Bulk Shield Liner

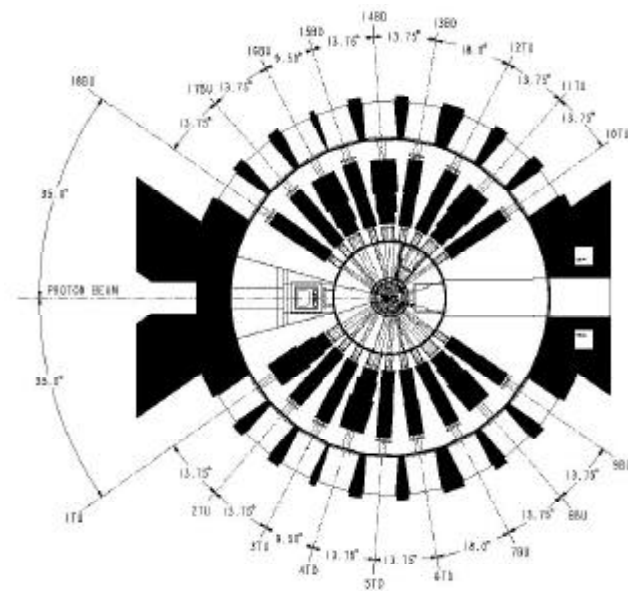


- Major components are:
  - base plate
  - faceted cylindrical section
  - target cart liner
  - flanges for neutron beams
- Some consideration being given to a shorter liner terminating above the neutron beam ports.

# Shutter System

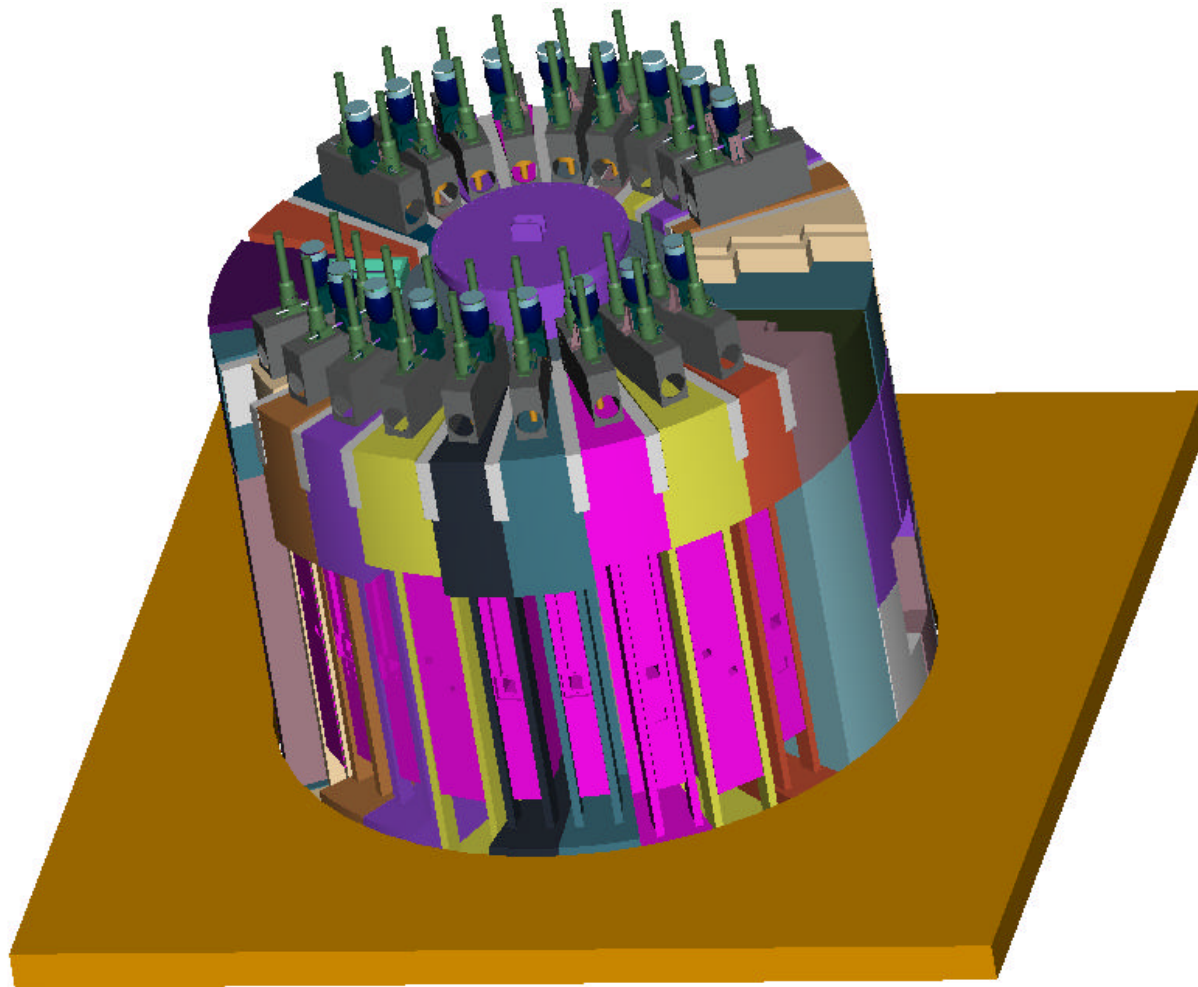


- The Shutter sub-system is the most complex within Shielding because it involves large shutter gates which translate vertically in a carefully controlled manner in accurate guides.
- There are two major types of shutter gates:
  - Single Channel Shutters
    - Facing Top Moderators
    - Facing Bottom Moderators
  - Multi-Channel Shutters
    - Facing Top Moderators
    - Facing Bottom Moderators





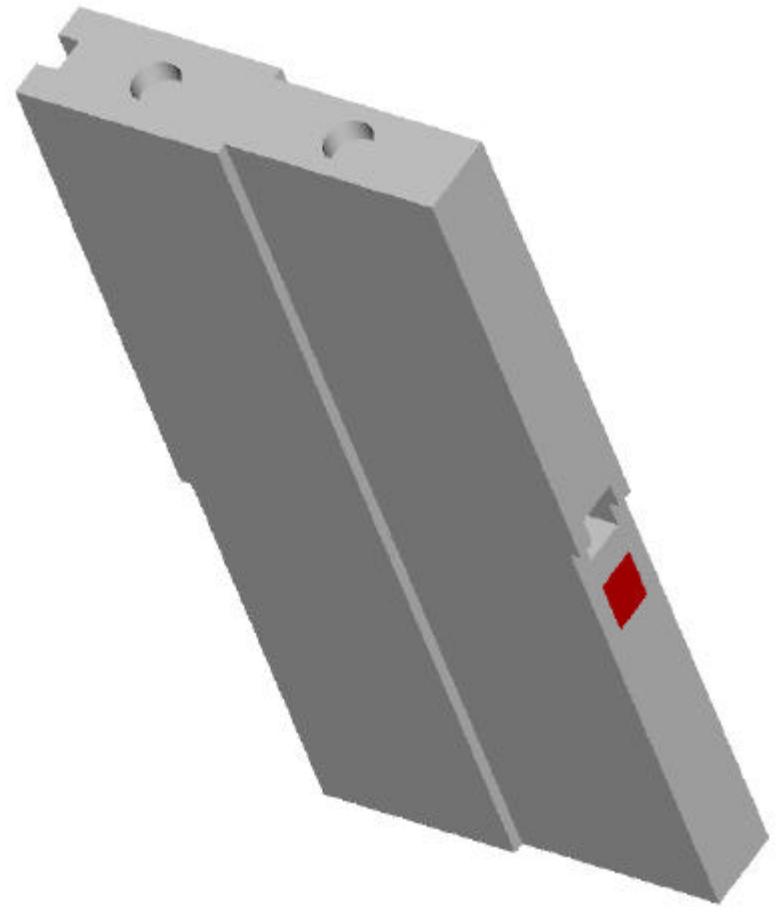
# Shutter Assembly with Other Shielding Components



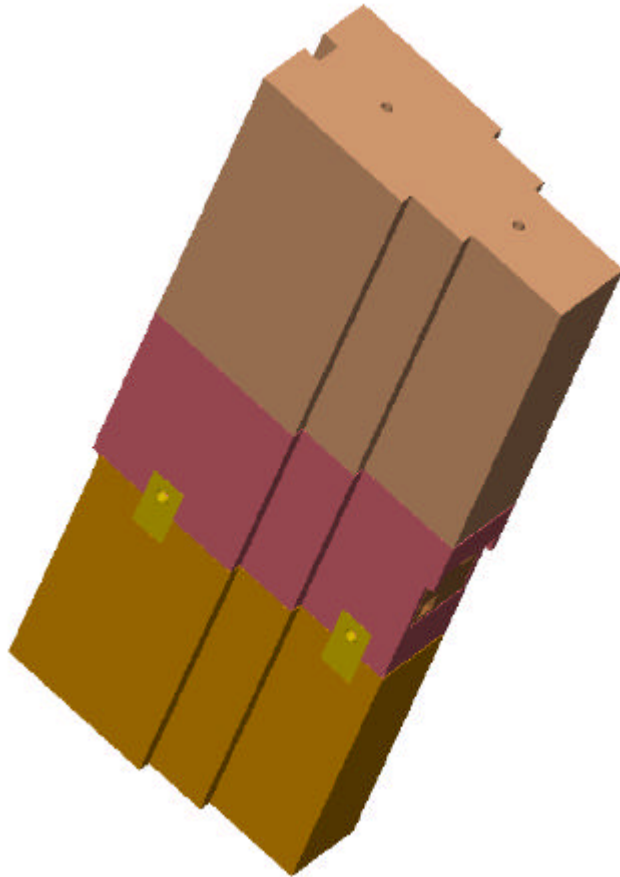
- Reduce radiation from target to 10 mrem/h in closed position at 10 meters from moderator.
- Hold position within 0.125 inches.
- Be capable of maintenance with 50 ton high bay crane.
- Shutter gates must accommodate inserts with utility access.

# Shutter Gate

- There are six single channel shutter gates and each will weigh about 30 ton.
- The shutter is equipped with a beam stop tungsten plug shown in red.
- The shutter is stepped to reduce radiation streaming
- The shutter has a reduced section on the lower half to allow the insert to be supported independently.



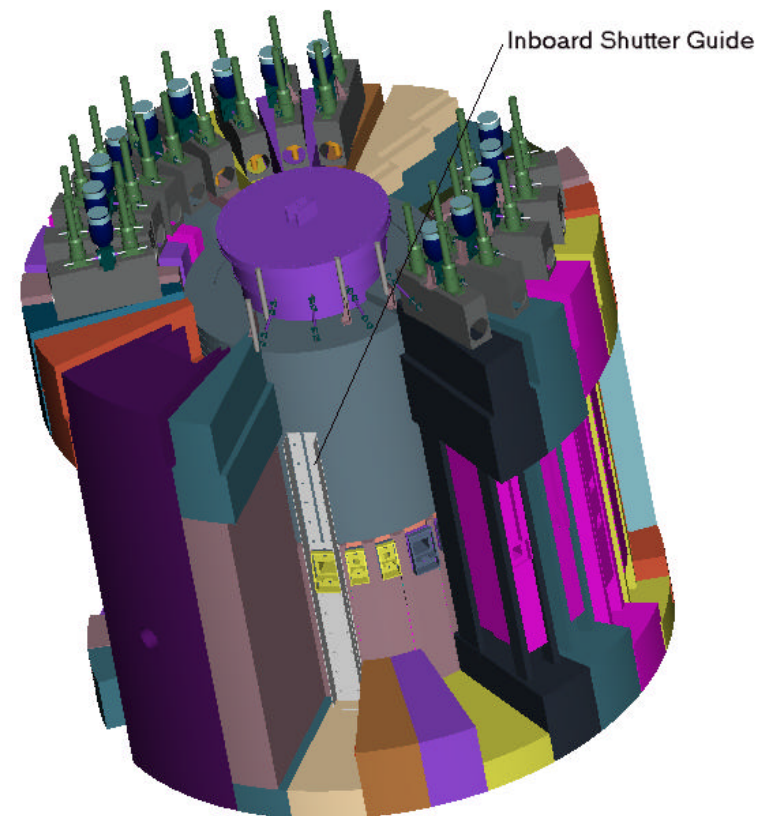
# Multi-channel Shutter Assembly



- There are 6 multi-channel shuttters
- These assemblies will weigh between 55 and 80 ton.
- They will be segmented to allow for disassembly
- The center segment will be an instrument systems responsibility to allow for flexible configurations.
- Tungsten beam stop will be located in lowest segment.

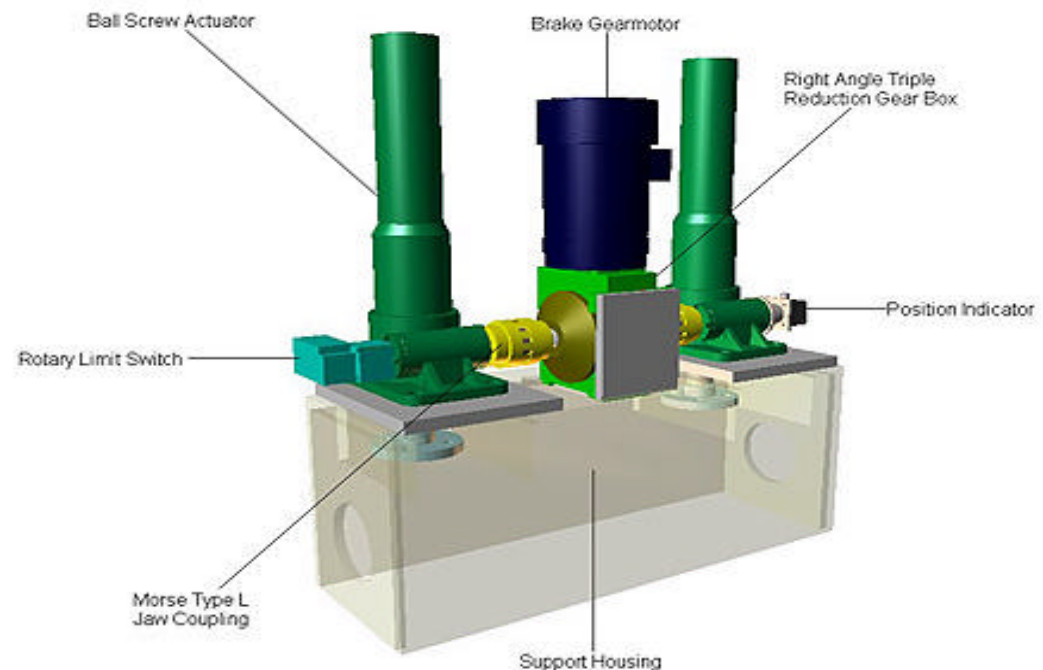
# Shutter Guides

- The shutters will be guided with accurately positioned guides to make certain that the inserts are in the correct position.
- The inboard guides will be mounted to the vessel support ring.
- The outside guides will be supported and accurately positioned.

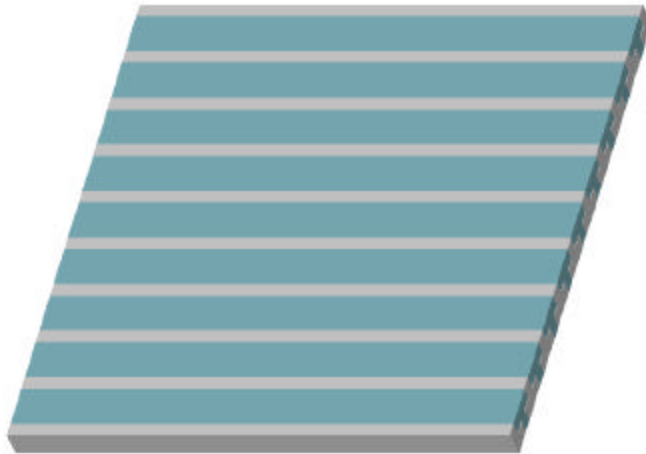


# Shutter Drive Requirements

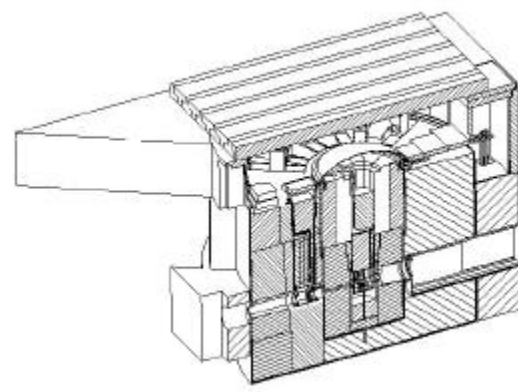
- Raise and lower 27 tonne and 72 tonne shutters
- Raise and lower the shutter gates 0.38 or 0.75 meters
- Operate at 0.2 to 0.75 meters/minute
- Provide braking and/or holding of the shutters in the raised position
- Operate independently of other shutters
- Minimize maintenance requirements



# Shine Shield System



- The reinforced concrete “T” beams that form the cover over the top of the shield stack.
- The membrane cover that covers the “T” beams and reduces the activated air migration.





# Current Status

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- Title I design efforts have resulted in assembly models and an integrated connection to other systems. Title I Review completed.
- Detailed Title II drawings should be complete about January 2001.
- Recently the project team has implemented accurately placed inserts in the plug region and shutters to enhance neutron flux at the instruments.
- The chopper enclosures have been reduced from caves with hatches to simple shallow archways.
- We anticipate a few more possible changes:
  - Shorter liner
  - Moving the liner interface radially in to the shutters
  - Integrating the seismic restraints with the vessel to the building structure